EGYPTIAN IMPORT DEMAND FOR UNITED STATES WHEAT

By

REGINA PANA-CRYAN

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Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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REGINA PANA-CRYAN

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Chairman: Dr. Robert D. Emerson
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Wheat is Egypt's leading food staple and the country faces water and land constraints. Most of the domestically produced wheat is home-consumed and does not reach the market. Egypt has been the third largest wheat importer in the world and wheat imports are increasing.

The Egyptian import wheat market is important for US wheat producers and exporters. Potential exists for increased wheat exports to Egypt that could benefit not only US wheat exporters but also the whole US agricultural sector, given the importance of wheat. In addition, many developing countries face situations similar to Egypt's; therefore, a model developed for Egypt could be adjusted and used for other countries as well.

In this study a geographical allocation model is developed for Egyptian imported wheat, in order to assess the US versus its competitors' position in this market.

The study concludes that the US is expected to expand its exports of wheat to Egypt if more expenditure is allocated for this good. Wheat imports from different countries seem to be uniform substitutes. The estimated model predicts what percentage change in quantities imported to Egypt from different sources will result from a percentage change in the wheat offering price by an individual supplier, assuming that all other suppliers keep their offering prices constant.

CHAPTER 1

INTRODUCTION

Egypt was the largest import market for US wheat in 1995 (United States Department of Agriculture (USDA), 1996). This dissertation explores the allocation of import demands for wheat by Egypt to determine the potential for a continuing demand for US wheat in this market. Since the import demand must be considered within the national setting, summary information about Egyptian agriculture, recent political and economic history, and agricultural policies focusing on food subsidies and the ration system and how these apply to wheat are discussed in this chapter before proceeding to the analytical and empirical models. In the last section of the chapter a brief literature review is presented, that discusses studies on Egypt, which focus on economic development and trade and how these are affected by existing domestic policies and the policies of trading partners.

Background Information on Egypt

The Land and the People

Egypt covers an area of 386,000 square miles, of which less than 4% is habitable and occupied by 98% of the total population. Egypt is the only developing country that is almost completely dependent on irrigation. The only water

source is the Nile, which makes expanding the arable land base very difficult, especially considering the continuing loss of agricultural lands to urbanization (Robinson and Gehlhar, pp. 1 and 3). In addition, the water supply from the High Aswan Dam is governed by the existing sharing agreement with Sudan (World Bank, 1993). It seems that attempts to reclaim desert land were high-cost and resulted in low-productivity operations, so that the land suitable for the production of most crops has already been brought into production (Antle, p. 173). Hansen agrees on the failure of reclamation; he maintains that in the 1960s about three-quarters of all agricultural investment was spent to reclaim 0.9 million feddan (1 feddan = 1.038 acre = 0.42 hectare) in the Western Desert, resulting in less than two-thirds of this land ever being cultivated at marginal returns (Hansen, p. 120). Since total cropland has remained the same since 1960, increases in agricultural production are due to more intensive cultivation (Dethier, p. 3). Environmental problems arise from the extensive use of chemicals, poor drainage, and intensive water use. There are fewer than 3 harvested feddan per agricultural laborer.

Excluding agriculture, there are few natural resources in the country. In the early 1970s, oil and gas fields were discovered, which now provide much of the foreign exchange earnings for the country. Foreign exchange is earned through

worker remittances, energy, tourism, cotton and textiles, in order of importance.

Population has more than doubled since the 1950s, and now exceeds 50 million (Table 1). While population has been increasing by more than 2% per year since 1960, Gross National Product (GNP) per capita increased moderately until 1987, but then declined until 1991 (Table 1).

Agriculture's share in total employment declined from 55% in 1965 to 40% in 1992, while agriculture's share in Gross Domestic Product (GDP) fell from 29% to 18% for the same period (Table 1). Agricultural exports as a share of total exports have declined from 71% in 1965 to 13% in 1992 (Table 2). The aggregate growth rate and productivity of the sector have declined since the mid 1960s. The increase in production from 1978 to 1983 was caused by increases in production of vegetables, fruits, livestock and dairy (Dethier, pp. 16-17). There have been substantial increases in wheat yields during the 1980s following the adoption of high yielding varieties.

Major producing crops are maize, rice, wheat, sugar cane and cotton. Although self-sufficient in the 1970s, Egypt was importing more than one-half of its food requirements by the mid-1980s. Major imports are wheat and wheat flour, corn, vegetable oils, sugar, and meat. The total and agricultural import and export values for recent years are presented in Table 2.

Table 1. Population, Agriculture's Share in GDP, GDP per Capita and Labor Force, Egypt, 1965-92.

Year	Population/a Total 1000	Rural % of total	Agricult. Share in GDP/b	GNP per capita/c $US	Labor Force/d Total 1000	Agricult. % of total
1965	29389	59	29	172	8130	55
1970	33053	58	29	202	9172	52
1975	36289	57	29	320	10037	49
1980	40875	56	18	500	11240	46
1985	46511	56	20	670	12786	43
1990	52426	56	18	610	14514	41
1992	54842	56	18	660	15275	40

Note: c/ Calculated by the Atlas Method, by the World Bank.
Sources: a/ Food and Agricultural Organization of the United Nations (FAO), AGROSTAT, b/ World Bank, World Tables, c/ World Bank, STARS, d/ FAO, AGROSTAT.

Table 2. Total and Agricultural Imports and Exports, Egypt, 1965-92.

Year	Imports			Exports		
	Total $US	Agric. 1000	Agric. % of total	Total $US	Agric. 1000	Agric. % of total
1965	9335	2947	32	6012	4282	71
1966	10705	3243	30	5991	4256	71
1967	7920	3471	44	5578	3998	72
1968	6660	2519	38	6199	4350	70
1969	6377	2208	35	7447	5107	69
1970	7702	2140	28	7614	5125	67
1971	9198	3163	34	7893	5575	71
1972	8988	2897	32	8252	5117	62
1973	9075	3197	35	11163	7162	64
1974	23518	12060	51	15165	9824	65
1975	39345	14174	36	14022	7821	56
1976	38082	13765	36	15220	7336	48
1977	48162	15474	32	17083	8228	48
1978	67279	19971	30	17375	6638	38
1979	38386	16684	43	18403	6058	33
1980	48615	23503	48	30469	6773	22
1981	88395	36355	41	32322	7405	23
1982	90806	32167	35	31211	6729	22
1983	102783	33037	32	32157	7264	23
1984	107690	39415	37	31408	7561	24
1985	99645	37098	37	37153	6616	18
1986	115055	33427	29	29351	6694	23
1987	119410	26136	22	20372	6725	33
1988	86573	31960	37	21204	5138	24
1989	74477	31930	43	26478	5325	20
1990	92020	30878	34	25850	4270	17
1991	78620	25849	33	36590	3910	11
1992	82930	26244	32	30500	4012	13

Source: FAO, AGROSTAT.

Political and Economic History[1]

In 1952 King Farouk was overthrown, and in 1954 the military took over under Colonel Nasser. Some of the wide-ranging reforms imposed were the redistribution of land, the promotion of industrial development and the expansion of social welfare services. In 1956 a new constitution was proclaimed. During the 1950s, the government under President Nasser nationalized private industry, closed the economy to Western investment and created a huge public sector, with 70% of the country's industrial output being provided by State enterprises. Administered prices and an extensive food subsidy system were established.

In 1970 President Nasser died and was succeeded by his Vice-President Anwar Sadat, who strengthened relations with Israel and introduced a more liberal political and economic regime. President Sadat started liberalizing the economy, establishing an "open door" policy in 1974 to encourage foreign investment. Price controls were loosened, and private farmers, as opposed to cooperatives, were favored. The pace of price liberalization policies had to be slowed after riots in 1977, caused mainly by the increase in price for subsidized bread. In 1981 Sadat was assassinated by Islamic fundamentalists and was succeeded by his Vice-President Hosni Mubarak. While the liberalization of the economy continues,

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[1] The information for this section is from the Europa World Yearbook.

foodstuffs and petroleum are still heavily subsidized and considerably strain the country's finances.

During the planning period, between 1960 and 1965, the economy grew at an average annual rate of about 6%. Between 1965 and 1973 it slowed to an average annual rate of 3%, due to warfare with Israel. From 1973-80, oil prices soared, the economy boomed and the demand for imported goods, especially foodstuffs increased. The subsequent drop in oil prices depressed foreign exchange earnings and remittances, and GDP grew at an average 1.4% between 1986 and 1989. Food import dependency increased to 50%, although agricultural production almost kept pace with the population growth rate at 2.4%. By the late 1980s the need for economic reform was apparent. In 1987 and 1988 Egypt's debt of $6.5 million to Western developed countries was rescheduled. The existing multiple exchange rate was partly unified, some public enterprises were reformed, and producer prices were raised. In 1991 the country reached an agreement with donors for $380 million aid under comprehensive accelerated reforms. The commitment to these reforms resulted in the Paris Club restructuring the country's private commercial external debt, the US and Gulf State creditors canceling $13 billion in debt, and a set of Western donors establishing a special compensation fund to cover the cost of structural adjustment and to absorb the displaced workers from Iraq and Kuwait.

Agricultural Policy Objectives and Instruments

Egyptian agricultural policy has two stated broad objectives: first, to provide an adequate supply of food staples to all income groups, and second to achieve self-sufficiency in strategic food crops. Lesser objectives aim at increasing farm income, insulating producers from international price fluctuations, and conserving foreign exchange. The worsening balance of trade and the liberalization of the economy seem to call for a redefinition of these objectives, especially those of self-sufficiency and producer protection.

Policy instruments include price policy, quota deliveries, input subsidies, exchange rate management and trade controls. Eight different government entities are responsible for decision making or program implementation.

Tariff rates have been declining for most goods by 10% a year (Foreign Agricultural Service of the United States (FAS), p. 6) and the products requiring import authorization by the government have been reduced.

Food Subsidies[2]

> These subsidies . . . alter prices of goods both domestically and relative to traded goods; they figure prominently in government expenditures; they are an instrument in income redistribution; they affect the volume of imports and exports of food and other goods; they affect investment and economic growth; they affect the country's balance of payments; and they leave their mark on foreign policy. Their size and pervasiveness

[2] The information for this section is from von Braun and de Haen, unless otherwise indicated.

> make them important to consider in any analysis of the economy. At the same time, their ramifications are so wide spread that it is difficult to disentangle their effects. (Scobie 1983, p. 11).

Scobie describes the development of the system as follows. Ration cards were introduced during World War II, and slowly a system of rationing and subsidies on consumer commodities developed. Expenditures on these subsidies were estimated to be less than 2 Egyptian pounds (LE) per capita (in constant 1975 prices deflated by the consumer price index) until 1973, or about 1% of national income. They increased to LE 6.2 in 1972-74, and by 1981 reached LE 20 (Scobie 1983, p. 12). During 1967-1973 the country's resources were devoted to military expenditures. After the 1973 war, however, the open door economic policy was implemented, which was supposed to also result in less state involvement in domestic economic activity. Instead, government expenditures on social programs were increased. Wheat and flour subsidies were around 45-60% of total food subsidies (Scobie 1983, pp. 12-13), which was a significant portion of total consumer subsidies.

Policies related to food subsidies are area allotments, procurements, direct and indirect price controls and input pricing and allotment.

The producer prices for cereals, industrial crops, oil seeds and fodder are fixed, and have been historically below world prices. Inputs (fertilizers, pesticides, access to mechanization, etc.) have been subsidized and water is free, as was already mentioned in the introductory section.

Procurement consists of compulsory delivery at fixed prices. There has been variation of the required percentages of production through time, and there have been data inconsistencies for some years for some crops. The requirement for wheat had been between 15-20%, but dropped to around 7% after 1977. Wheat procurement prices were similar to import prices, when converted at official exchange rates. After 1973-74 world prices increased, with procurement prices increasing more slowly. In 1975 import prices started declining, while procurement prices kept increasing. This led to the eventual reduction of wheat procurement and increasing imports. By 1994 all procurements were voluntary, including that of cotton, for the first time (FAS, p. 10).

The Ration System[3].

Wheat flour and bread are available at subsidized prices to all consumers with no restrictions, while rice, tea, cooking oil and sugar comprise the "basic ration." They are rationed into monthly quotas and are sold at subsidized prices through ration cards. There is allowance for an additional ration at subsidized, but higher prices. Contrary to the usual situation in other developing countries with similar systems, the rural areas in Egypt are reasonably well served by government controlled subsidized food distribution. More than 90% of the households possess ration cards. Excluded are

[3] The information about the ration system is from the household survey conducted by Alderman and von Braun in 1981-82, unless otherwise indicated.

households with more than 10 feddan, and those whose head is working abroad. Over-reporting is in general not a problem.

Subsidized flour is available in specialized flour shops and, to a lesser extent, in the government cooperative shops that distribute ration card goods. Frequently, it is only available at fixed days of the month, with regulations that change according to location and over time. In 1981-82, more than 75% of urban and about 25% of rural households had access to subsidized bread without quantity restrictions, and one-fourth of rural and one-fifth of urban households indicated limitations in bread supply.

Alderman and von Braun argue that bread is not used for animal feed, because even the cheapest bread is more expensive than the farm gate price for corn, because it is considered immoral to feed it to animals, and finally because it is not available in bulk. Calculating percentages of waste (bread used for backyard or "urban" agriculture, and bread thrown away) they conclude it amounts to less than 4% of the amount spent on wheat subsidies.

Urban consumers purchase a greater proportion of their food than rural ones through outlets with fixed prices (cooperatives, government flour shops, licensed bakers). Ration distributions are rarely a family's only source for the commodities. Therefore, rations at subsidized prices can be considered income transfers. So, many households purchase much beyond ration levels, and these quantities often exceed

the rationed ones (Alderman and von Braun, p. 24). More bread is consumed in urban, and more flour in rural areas. In grain equivalents, rural households purchase more, mostly unmilled wheat.

Previous Studies on Egypt

Many recent studies on Egypt focus on political economy issues. A thorough work in this area was conducted by Hansen (1991), who compares Egypt's and Turkey's policies, institutions and politics, in this way presenting a comprehensive study on the contemporary political economy of the two countries. Among the issues he examines are the lack of growth in total factor productivity in both countries, the different degrees of success in educating the people of each country, the role of domestic politics on development and the difference in agricultural growth in the two countries. With respect to this last issue, he claims that Turkey's growth can be attributed to the expansion of the cultivable land until 1960. In contrast, Egypt has faced a land constraint since the beginning of the century. He concludes that Turkey's inability to expand cultivable land after 1960 is the reason for the sluggish agricultural growth observed since then. Another thorough study by Dethier (1989) examines Egypt's agricultural pricing policy from a political economy perspective. His main conclusion is that the stated objectives of the Egyptian agricultural policy, to provide adequate basic foods to the population and achieve food self-

sufficiency, conflict. This creates increased inefficiency and rising government expenditures. He claims that price stabilization was achieved, but it increasingly required allocation of foreign exchange to food imports, as well as deficit financing.

Most of the economic studies of Egypt are descriptive. For example, Handoussa (1991) studied the effect of foreign aid on Egypt's development, and the World Bank (1993) constructed a framework in order to assist the Egyptian government in developing the agricultural sector. The International Food Policy Research Institute (IFPRI) published a series of works in the early 1980s, that focused on Egypt. These include the descriptive studies already mentioned above, by Alderman and von Braun (1984) and von Braun and de Haen (1983), that discuss the effects of food pricing policies and rationing on Egyptian agriculture, income distribution and consumption.

Quantitative economic studies on Egypt are mostly conducted through the use of Computable General Equilibrium Models (CGE). For example, Robinson and Gehlhar (1994) used such a model to examine the effects of economic liberalization on water and land, two scarce resources in Egypt. Two IFPRI publications by Scobie (1981, 1983) utilize complete demand systems to assess the impact of government policies on foreign exchange and trade, and specifically food imports. The earlier work assumes a foreign exchange constraint and, based

on that, allocates total import expenditures on total wheat imports, other imports and foreign reserves. Then the effects of consumer subsidies, foreign aid and domestic supply on the wheat import market are assessed. Whereas this study is comprehensive and interesting, and ideally would be updated and expanded for the present study's purposes, data is limited with respect to both accuracy and availability. Obtaining consistent data series for consumer and producer subsidies seems to present the most difficulties, but other data series are problematic as well, for example, finding consistent and comprehensive aid figures.

As will be discussed in the next chapter, this study will assess the US position in the Egyptian wheat import market with respect to its competitors. As far as the author knows, there have been no previous studies examining this specific problem in any framework.

CHAPTER 2

PROBLEM STATEMENT AND OBJECTIVES

The Current Situation in the Wheat Import Market and the US Role

In 1992 and 1993, wheat, wheat flour and corn imports from the US accounted for 77% of total US agricultural imports to Egypt. Table 3 presents the US share of quantity of wheat and wheat flour, and Table 4 presents the US share of value of total food, wheat and wheat flour imports to Egypt. These shares include aid shipments. In 1993, the value of unmilled wheat and wheat flour imports to Egypt from the US was $156.6 and $57.9 million, respectively. The following subsection examines the wheat market in detail.

Wheat and Wheat Flour[1]

The government has a monopoly in imports and has been responsible for the distribution of both domestically procured and imported wheat. In 1991, about two-thirds of total commercial wheat was distributed by the government. The same year, nonbread use accounted for 5% of total commercial wheat. Out of the portion distributed by the government, about 66% was used for balady bread, the cheapest kind, 14% for shami, which is more expensive, and the rest for fino, a high priced, nonarabic bread, and flour.

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[1] The information for this section is from Parker and Shapouri, unless otherwise indicated.

Table 3. Share of US to World Quantity of Wheat and Wheat Flour Imports to Egypt, 1965-93.

Year	Wheat	Wheat Flour
1965	61.86	30.70
1966	80.89	52.04
1967	8.41	1.87
1968	0.00	0.00
1969	0.00	0.00
1970	0.00	0.00
1971	0.00	0.00
1972	0.00	0.00
1973	9.55	3.58
1974	29.31	0.00
1975	38.66	13.71
1976	49.26	40.76
1977	50.82	42.69
1978	37.90	36.60
1979	52.20	33.63
1980	46.94	51.56
1981	56.75	29.38
1982	67.08	38.06
1983	48.85	82.12
1984	25.93	30.31
1985	29.54	33.20
1986	38.00	44.44
1987	49.49	56.70
1988	43.17	54.58
1989	67.88	61.66
1990	28.49	47.86
1991	42.18	73.58
1992	71.56	51.79
1993	52.32	42.42

Source: Calculated from United Nations, Commodity Trade Statistics.

Table 4. Share of US to World Value of Total Food, Wheat and Wheat Flour Imports to Egypt, 1965-93.

	Wheat	Wheat Flour	Total Food
1965	63.33	33.80	40.02
1966	80.79	55.31	43.84
1967	8.38	2.11	5.46
1968	0.00	0.00	0.50
1969	0.00	0.00	2.31
1970	0.00	0.00	2.56
1971	0.00	0.00	1.76
1972	0.00	0.00	2.25
1973	12.18	5.98	10.96
1974	28.82	0.00	27.67
1975	40.84	10.62	30.93
1976	46.18	42.95	35.45
1977	51.27	41.78	36.30
1978	40.85	40.83	28.52
1979	61.15	37.25	34.30
1980	50.01	52.30	36.34
1981	57.73	26.77	37.98
1982	67.17	39.98	39.37
1983	48.82	82.06	35.67
1984	25.97	31.53	22.13
1985	25.62	35.40	23.49
1986	34.43	47.36	28.10
1987	45.17	59.44	29.39
1988	46.19	55.24	25.23
1989	66.69	64.54	36.63
1990	28.33	41.97	23.46
1991	42.39	75.57	27.27
1992	67.85	55.05	34.25
1993	46.68	41.51	30.96

Source: Calculated from United Nations, Commodity Trade Statistics.

Egypt has been a recipient of US export assistance under programs such as PL-480, the Export Credit Guarantee Program (GSM-102), and the Export Enhancement Program (EEP). Australia and the European Union (EU) have also been providing wheat and wheat flour aid to Egypt. The quantities in metric tons (MT) in grain equivalents (to convert flour to grain equivalent one needs to divide flour quantities by 0.73) for wheat and wheat flour from different donors are shown in Table 5.

The US is the leading supplier of wheat for Egyptian imports and competes with Australia and the EU for that market. After 1991, private imports of wheat were allowed, but the bulk of wheat imports are still handled by the government. The Australian wheat is preferred for its high quality, and the US wheat follows in order of preference, due to its higher moisture content, and variability in its quality. The main quality consideration is live insects and insect damage.

Wheat is the country's leading food staple, accounting for half of the calories in the daily diet as bread and wheat products. Most of the domestically produced wheat is consumed at its production site, with less than 10% sold to the government. Imported and domestically procured wheat is processed in government run mills and sold at subsidized prices. Producer prices have increased, yields have increased and government provides mechanical drill planting. As land rents are deregulated and the input distribution system is privatized, the cost of production is increasing.

Table 5. Aid Shipments of Wheat and Wheat Flour in Grain Equivalents, by Selected Donors, Egypt, 1974-93.

Year	US/a	EU	Australia
	---------- MT ----------		
1973	1300	181350	0
1974	5088	100980	0
1975	441377	104400	0
1976	690490	98320	10000
1977	1193610	96800	0
1978	983451	137113	20000
1979	1081650	202342	22300
1980	1035325	145802	20000
1981	1060840	154035	25000
1982	1168967	178010	40000
1983	985056	205367	40000
1984	974947	187535	80000
1985	977907	195340	40000
1986	984940	120000	40000
1987	1024226	301913	50000
1988	793038	284747	50000
1989	602829	135200	50000
1990	755537	150573	0
1991	1459000	305789	60500
1992	456045	134000	48416
1993	632611	130147	0

Sources: a/Quantities for years 1974-90, are PL-480 shipments from Parker, J. and S. Shapouri, Determinants of Wheat Import Demand: Egypt, p. 8. The rest are from FAO, AGROSTAT.

Egypt is the third largest wheat importer in the world after the former Soviet Union and China[2]. Egypt's milling capacity is expanding, and imports of wheat flour are declining. Several Egyptian companies are in the process of importing flour milling equipment in order to run their own mills and avoid renting public enterprise sector milling capacity (FAS, p. 27).

Problem Statement

Wheat is Egypt's leading food staple and the economy's liberalization is resulting in increased costs of production. Limited water availability is another constraint for domestic production. Since all agriculture is irrigated in Egypt, and water use for irrigation has been free, it seems that with the economy's liberalization the price of water might become positive. Even if that does not happen, it would be more profitable to grow crops with higher returns per feddan than wheat. For example, Sarris claims, that since past studies show that self-sufficiency in wheat is technically infeasible, a shift of production toward high valued tradable products, like horticultural ones, is advisable (Sarris, p. 55). While wheat yields have been increasing, due mainly to the adoption of high-yielding varieties, the country faces a land constraint. As mentioned above, most of the domestically produced wheat is home-consumed and does not reach the market. Egypt has been the third largest wheat importer in the world, private wheat imports are increasing, and private mills are starting to operate.

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[2] This statement is consistent with the opening statement of the previous chapter; the latter refers to US exports.

The Egyptian import wheat market is important for US wheat producers and exporters. US agricultural exports to Egypt account for 41% of its total exports to North Africa, and amounted to $766 million in 1992, and $661 million in 1993 (USDA, 1994). The value of unmilled wheat and wheat flour exported from the US to Egypt in 1993 was $214.5 million. In addition, due to reasons explained in the previous paragraph, there is potential for increased wheat exports to Egypt. The expansion of the Egyptian wheat import market could be beneficial not only for wheat exporters in the US, but for the whole US agricultural sector, since production and exports of grains in general, and wheat specifically, have been and will continue to be very important for US agriculture. Therefore, the potential for increased access to export markets is of considerable interest. A model of wheat import demand for Egypt that incorporates the US and its major competitors for this market will be used to assess the US role in this market. Also, some insight on how wheat imports relate to considerations such as food subsidies, foreign aid and domestic wheat production will help assess how wheat imports would be affected by likely future changes in those items.

Furthermore, situations similar to Egypt's are faced by other developing countries. Constraints in basic food production due to limited resources and heavily distorted domestic markets are common in developing countries. Governments in developing countries are starting to realize that agriculture has to be a productive sector of the economy, and that heavy consumer subsidies and other

interventions are unsustainable in the long run. At the same time, international development agencies and donors are insisting on liberalization of the economy as a prerequisite for continuing assistance to developing countries. The US is a major competitor in the world grains market and an important source of grain imports for many developing countries. The framework developed here to examine the Egyptian wheat import market could be adapted for other developing countries that import grains from the US and have economic distortions that may be eliminated.

Objectives

Specifically, the proposed import demand model will address the following:

1. Assess the US' versus its competitors' positions with respect to the Egyptian import wheat market, by examining in detail the substitutability between wheat from different sources of origin.

2. Assess the effects of policy changes in Egypt and in the supplier countries, with respect to their implications for current and future Egyptian import demand for wheat.

In the following chapters, the connection between the problem at hand and empirical demand analysis is first established. In order to do that, theoretical and empirical issues concerning demand analysis are examined and related to the Egyptian case. The proposed methodology is then presented, with subsections examining specific issues, such as incorporating theoretical restrictions

into the empirical model, describing the system-wide differential approach, preference structures and how they can be used to derive conditional demand systems, and the Rotterdam model and how it is used to build a conditional geographic import demand system. Then the data and estimation results are presented. Finally, conclusions and suggestions for further research are discussed.

CHAPTER 3

THEORETICAL AND EMPIRICAL CONSIDERATIONS

Demand Analysis in Theory and Practice

Most literature reviews on demand analysis stress that, while applied work has to build on theory, the tools that theory provides at its present state generally do not deal explicitly with the problems encountered in practice. Surveys of developments on combining demand theory and applied demand analysis are presented by Brown and Deaton (1972), Powell (1974), Theil (1980) and Barten (1977).

The first of the above mentioned works, is a thorough survey of models of demand analysis. The authors mention that agricultural commodities were the first to be used for applied analysis, because single-equation partial equilibrium analysis is best suited to examine "a homogeneous commodity with a single quantity dimension, stable consumer preferences, and relatively large fluctuations or trends in supply which are independent of the current market price; and these conditions are most nearly met by many agricultural staples" (Brown and Deaton, p. 1147). Referring to the empirical issues of demand analysis encountered since the 1950s, the authors claim that focus has shifted from the classical approach, which is concerned with what values the price and income elasticities

of a commodity should be, to methodological questions that deal with how these elasticities should be measured.

They define as "pragmatic" the ad hoc approach, where the variables we are directly interested in are included in the analysis, while others are ignored or summarized (Brown and Deaton, p. 1151). Then they claim that it is better to construct models for which the restrictions implied by theory can be imposed and tested, for which the pragmatic approach does not account. Following this line of argument, a model of a system of demand equations not a single equation approach is to be used for this study. This way, the theoretical restrictions can be imposed and tested and the interactions between wheat from different sources of origin can be explicitly accounted for. In addition to conforming to demand theory, the imposition of these restrictions also serves to reduce the dimensionality of the estimation problem and to deal with certain shortcomings of the available data, as Barten claims in his survey of demand systems (Barten, 1977, p. 23).

In the sections that follow, several issues are addressed that have important implications in applied demand analysis, and for which theory does not provide a clear direction. The most important of these issues are identification and aggregation among consumers and commodities.

Exogenous Prices

Brown and Deaton claim that strong assumptions must hold regarding supply conditions, in order to assure that one estimates demand, instead of a function that represents supply or a mixture of supply and demand. Prices are usually assumed fixed by producers or on world markets, with supply forthcoming at that price. Then demand equations are written with quantities dependent on prices and income.

For the Egyptian case, an argument can be made in favor of the exogeneity of world prices, since for trade purposes, Egypt is reasonably assumed to be a small country. Despite the fact that Egypt is the third largest wheat importer, it seems that it can not affect the prices its suppliers charge. Furthermore, there have been no quantitative controls for imported wheat to Egypt, only tariffs, which strengthens the argument in favor of exogenous prices. In the proposed framework, savings are ignored and income is equivalent to total expenditure, so that the allocation of that quantity is examined and not of income (Brown and Deaton, p. 1189).

To further examine the issue of world prices, one needs to look into the conditions that prevail in the domestic markets of the wheat suppliers to Egypt, namely the US, EU and Australian domestic markets.

Australia can be considered a small country for wheat exports due to the volume of their exports compared to the volume of exports that dominate the world market and originate

in US, Canada and EU. Also, the only domestic distortion is the existence of the Australian Wheat Board (AWB), which buys all the wheat produced and sets the domestic price higher than the one that prevails in the export market. This way the domestically demanded quantity falls and more wheat is allocated to the export market.

Figure 1 depicts the situation graphically. Domestic demand and supply are represented by curves D and S, respectively. Given the world price for wheat (Pw) total demand is the section of D above Pw that represents domestic demand, and Pw from that point on. Domestic quantity demanded is Qd and domestic quantity supplied Qs. Then exports are Qs minus Qd.

The AWB sets the domestic consumers' price at Pc, which causes the domestic quantity demanded to decrease to Qd'. Domestic producers receive the weighted average of the domestic (Pc) and export price (Pw), Pp. Then domestic quantity supplied increases to Qs'. Exports increase to Qs' minus Qd'.

The distortions in the Australian wheat market are minimal when compared to the distortions prevailing in the EU and US markets. Calculated in percentages for 1992, wheat producer and consumer subsidy equivalents were 7 and zero for Australia, respectively, while for the EU they were 47 and -38, and the US 37 and -15,respectively (Organization for

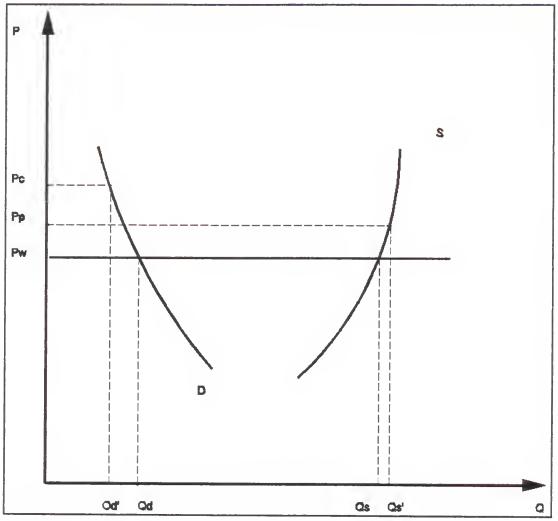

Figure 1. Australia as a Small Exporter of Wheat.

Economic Cooperation and Development (OECD), 1995, pp. 202-203, 214-215, 250-251).

The US policies that affect the export price for wheat are deficiency payments and export subsidies. Because the US is a large country for trade purposes, its domestic policies affect world prices. Both deficiency payments and export subsidies tend to lower world prices, even though that happens for different reasons and in different magnitudes depending on the policy.

Figure 2 depicts the US deficiency payments scenario. The first graph shows the domestic US situation, the middle graph shows the excess demand and supply (Trade), and the last graph shows what happens to the rest of the world (ROW). With a deficiency payment in the US, the domestic producer price will increase to P'. Excess supply will shift from S to S', so that the world price will decrease to P''. Domestic and foreign consumers pay P'' and domestic producers receive P' and supply more. Foreign producers are worse off, because they receive P'' and produce less, and US taxpayers are also worse off.

An export subsidy is presented in Figure 3. It would raise the producers' price to P' in the US, and domestic consumers will have to pay P' too. The effect of the export subsidy on the ROW is to depress the world price to P'', which is lower than the P'' that results from a deficiency payment.

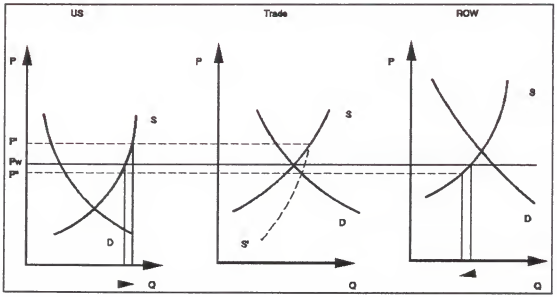

Figure 2. The US as a Large Exporter of Wheat and the Effects of a Deficiency Payment.

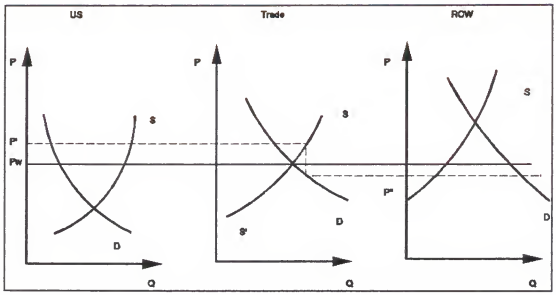

Figure 3. The US as a Large Exporter of Wheat and the Effects of an Export Subsidy.

The most important EU policy influencing the wheat export market is export subsidies. The difference between the US and the EU with respect to export subsidies is that without the subsidies the EU would be an importer. So, the situation for the EU is the same as the one for the US in Figure 3, except for Pw in the first graph being below the point where domestic supply and demand intersect.

On the Egyptian side, it seems that aid or political leverage is not a determining factor for the import prices that Egyptians face from the US, EU and Australia. When compared with another of the top three world wheat importers, China, it is observed that the trends in prices they face are similar, despite the fact that the countries are very different in size, geographical location and political leverage. Tables 6 and 7 show volumes and prices (calculated by dividing value by volume) of wheat imports for China and Egypt. More details on how aid is treated in this study are discussed in subsequent sections.

Because Egypt is a small country for trade purposes, domestic wheat supply does not affect world prices, and neither do domestic consumer subsidies. Figure 4 depicts the Egyptian situation. Before any intervention, supply is the part of domestic supply below Pw and Pw from that point on. The Egyptian government sets the domestic consumer price at Pc and the domestic producer price at Pp. Then the quantity supplied decreases from Qs to Qs' and the quantity demanded

Table 6. Wheat Import Quantities and Prices from Selected Suppliers, China, 1973-93.

	US		EU		Australia	
Year	MT	$/MT	MT	$/MT	MT	$/MT
1973	2648648	115.33	6	183.33	768462	75.80
1974	1905493	135.09	205007	157.05	1317839	159.12
1975	0	0.00	0	0.00	1327551	162.63
1976	0	0.00	0	0.00	933509	146.40
1977	0	0.00	0	0.00	2984537	102.58
1978	1847165	148.98	0	0.00	2434736	99.81
1979	1481818	158.94	90280	133.71	2968131	136.13
1980	5800684	197.09	134164	158.63	1997812	177.45
1981	7070873	197.41	632354	187.52	1242804	213.04
1982	6485523	177.53	706408	162.23	2113110	171.41
1983	2335435	177.89	813454	132.90	416391	157.84
1984	3818957	165.71	27000	174.70	2429362	166.86
1985	707929	150.74	320632	117.07	1254856	147.47
1986	3192	130.61	114374	106.75	2785944	119.59
1987	1563507	96.37	567649	114.60	4431620	97.48
1988	5768226	122.79	29996	180.02	397187	114.66
1989	8293176	171.45	1611679	172.36	1676585	182.52
1990	3919284	162.57	2173848	167.03	1386170	176.49
1991	4586557	107.71	1265591	113.93	1364645	119.18
1992	3334444	134.18	1340261	127.00	219065	163.79
1993	2588981	117.60	56915	180.01	618722	145.93

Source: Calculated from United Nations, Commodity Trade Statistics.

Table 7. Wheat Import Quantities and Prices from Selected Suppliers, Egypt, 1973-93.

	US		EU		Australia	
Year	MT	$/MT	MT	$/MT	MT	$/MT
1973	142273	119.50	510747	105.25	552062	67.34
1974	659692	259.78	674872	263.42	720354	273.26
1975	1036246	214.56	643252	192.31	833567	190.32
1976	1161329	156.07	434031	184.88	717455	169.01
1977	1229222	137.08	33862	162.57	506568	156.58
1978	1110820	155.97	352647	138.55	385684	120.51
1979	1175468	129.57	448524	81.71	237155	116.24
1980	998040	221.10	869179	194.99	243057	195.50
1981	1754962	249.62	399233	224.90	776029	246.35
1982	1958584	241.17	66690	161.91	709303	246.69
1983	1258829	192.62	511265	176.16	679186	208.27
1984	705752	197.60	263377	168.89	1102481	216.59
1985	690228	100.19	1002	125.75	1254326	127.08
1986	1293910	133.02	0	0.00	1805813	156.01
1987	1798248	96.10	188602	159.52	1405498	102.62
1988	1543623	131.07	365911	110.54	1591094	115.23
1989	2083433	187.54	289035	159.71	658692	208.25
1990	1269639	176.09	998034	160.71	1805461	184.93
1991	1736255	123.74	191156	170.35	1912098	117.77
1992	3552272	134.59	110000	155.10	1242054	161.48
1993	1224543	127.89	318774	137.84	755395	169.33

Source: Calculated from United Nations, Commodity Trade Statistics.

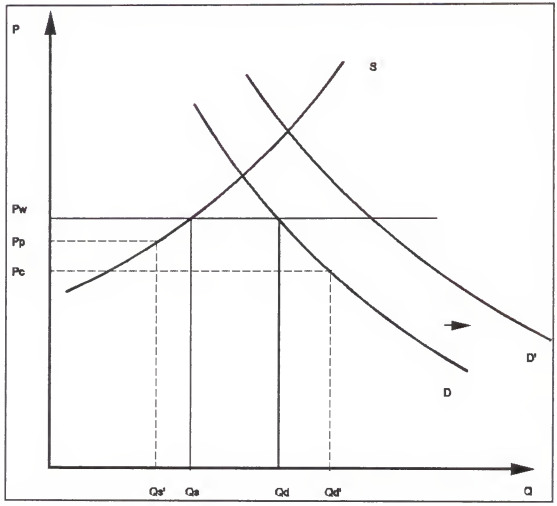

Figure 4. Egypt as a Small Importer of Wheat.

increases from Qd to Qd'. The effect of aid will be similar to that of increased income (Scobie, 1981; Handoussa, 1991). The demand curve D will shift out to D'. Pw is the average price of imports from different sources that the Egyptians face, for the study's purpose. It is assumed to be very close to the world price referred to in the analysis for Australia, US and EU, so that the connection between Egypt and its wheat suppliers is through Pw.

To summarize, for the purpose of this study, the wheat world price that Egypt faces every year is assumed to be the average price that results from dividing total value over total quantity of wheat imported from all sources. As a small country, Egypt does not influence this price. The similarity of import prices faced by China, implies that there are no political variables greatly affecting the levels of these prices either.

Aggregation and Separability

With respect to the aggregation problem, a distinction has to be made between aggregation among consumers and aggregation among commodities. According to Barten, "actual data usually refer to consumption for a limited number of highly aggregated groups of goods, for a whole economy, and for a relatively small number of years. The theory of consumer demand, however, is about individual behavior with respect to the choice of quantities of a potentially large number of elementary goods" (Barten, 1977, p. 23).

To deal with aggregation over consumers, most of the work done in applied demand analysis either ignores it altogether, or explicitly assumes a representative consumer. Ignoring the issue obviously does not solve it, while the shortcomings of the representative consumer assumption are pointed out by many authors. Exact aggregation over consumers implies very restrictive assumptions, for example, all consumers' Engel curves must be parallel straight lines. The methodology advocated in this study, explicitly accounts for the issue. As demonstrated by Barnett (1979; details on Barnett's approach in the methodology section) the proposed model is an aggregate rather than an individual consumer model, built with no restrictive assumptions on individual consumers' preferences.

The aggregation over commodities is usually treated by assumptions on separability, which refers to the degree of dependency among individual commodities and groups of commodities (separability is discussed further in the methodology section). The consumer is assumed to exhibit independent preferences for distinctively different commodities, so that for example his consumption of shoes would be independent of his consumption of butter. On the issue of separability among different groups of commodities, researchers' opinions vary. Moschini, Moro and Green (1994) tested for separability for food items and found that the widespread practice of modeling food items in terms of

conditional demand systems seems to be justified (they also present a literature review on the issue). Some of the works that found evidence against the separability hypothesis between imported and domestic goods are Winters (1984), and Brenton (1989), but these works involve the Almost Ideal Demand System (AIDS) model that does not nest separability. Truett, Truett and Apostolakis (1994) tested for separability of domestic inputs and imports using a translog cost function for Mexico, and could not reject it at the 5% level of significance but they could at 10%. The issue of separability is important for the derivation of conditional demand systems, as developed in the methodology section.

For the purposes of the study at hand, a decision had to be made on how to treat the separability issue. There seems to be evidence that the markets for Egyptian imports and domestic goods are separable. According to ez Elarab (1982), Egyptian imports were found to be weakly separable from domestic goods. This implies that the aggregate utility function is first maximized subject to GNP, and then two subaggregate utility functions are maximized: one in order to determine the demand for domestic and the other for imported goods.

As discussed in detail later, in order to estimate the allocation model, two further stages are assumed that utilize the separability concept. Imports are broken down to food and other and food is further broken down to wheat and other.

CHAPTER 4

METHODOLOGY

In this section, the different approaches to estimate demand systems are briefly discussed, and the general restrictions that theory requires to be imposed on these systems are presented. A discussion of the general differential model and the development of conditional empirical models follows. Then, the empirical models to be estimated will be presented, namely the Absolute Price Version (AP) and the Uniform Substitutes (UB) Version of the Rotterdam model, as different versions of a geographical allocation model.

Approaches to Demand Estimation and General Restrictions

As claimed by Clements, the estimation of systems of demand equations to determine empirical regularities in consumption patterns is one of the primary aims of applied demand analysis (Clements, p. 1). There are several approaches to derive systems of demand equations.

The older approach to demand analysis was to directly specify the demand for a good as a function of income and prices, without any reference to the utility function. A popular example is the double log system, which is attractive due to its simplicity, but does not satisfy the adding up

constraint for all values of income, meaning that if income rises sufficiently, expenditure on one good will exceed income.

Another approach of specifying demand systems is directly deriving them from a specified utility function. The consumer has a fixed amount of income to spend on n goods and services at fixed prices. To determine the quantities bought, assumptions about the consumer's preferences must be made, implied through his utility function. Maximizing the consumer's utility subject to his budget constraint, results in a unique demand function for each good. These demands are functions of income and prices.

According to Hicks, the utility function that is maximized represents a preference ordering, which implies that the demand functions derived are invariant under monotone increasing transformations of the utility function (Hicks, p. 307). It also implies that there could be no declining marginal utility for a good, because this property is not invariant under monotone increasing transformations of the utility function (Theil, p. 3).

Given that a consumer's commodity set is divisible, does not include negative commodities, and is unbounded from above, and his preferences satisfy the axioms of comparability, transitivity, continuity, monotonicity, strict convexity and differentiability, the consumer's "well-behaved" utility function can be defined.

To answer whether the utility function really exists, if the consumer wants to maximize it and if he does, whether he is he able to do so, Phlips maintains the following arguments. The utility function is a formal concept used by the economist, not the consumer, in order to describe the consumer's observed behavior in the market and to forecast his future behavior. Reality, expressed in statistical data, is intelligible when interpreted through a formal hypothesis imposed on the observed data. The economist, not the consumer, maximizes utility to find the optimal quantities the consumer purchases. The conclusions derived from the maximization of the utility function, refer to the demand equations, taking the form of restrictions imposed on these equations. Finally, he claims that "... applied consumption analysis appears then as the art of constructing and effectively utilizing interesting theoretical restrictions in the (econometric) estimation of demand equations" (Phlips, p. 27).

When a demand system is directly derived from maximizing a utility function of a specific functional form, it satisfies the general restrictions of demand functions. These general restrictions refer to homogeneity of degree zero, adding up, negativity, and symmetry.

Homogeneity of degree zero means that if prices and income are multiplied by a positive constant, the quantity demanded does not change. It implies that the sum of all

direct and cross elasticities with respect to prices for any commodity must equal minus its income elasticity.

Adding up means that the budget constraint must be satisfied, which implies that the marginal propensities to consume must sum to one.

Negativity and symmetry refer to the Slutsky equation, that shows that the change of the quantity demanded of a good to a change in its price, or any other good's price, can be decomposed into an income effect and a substitution effect. With respect to the substitution effect, one can conclude that the own substitution effect is negative and that the matrix of substitution effects is symmetric.

An example of a demand system directly derived from a specified utility function is the linear expenditure system (LES), which results from maximizing a Klein-Rubin utility function (Clements, p. 9). The LES does not admit inferior goods (it implies that as a consumer becomes richer, food becomes more of a luxury). This implication is true for all demand systems derived from a preference independent utility function (more details on preference independence are presented in the relevant section).

A utility expressed as a function of income and prices is an indirect utility function (can be derived by substituting demands into utility). Then the negative ratio of the derivative of utility with respect to prices to the derivative of utility with respect to income gives the quantities

demanded (Roy's theorem). The translog indirect utility function is an example.

The consumer's cost function is the dual to its indirect utility (can be derived by substituting cost as a function of utility and prices for expenditure in indirect utility), and shows the minimum expenditure to reach a specific level of utility given the prices. Differentiating the cost function with respect to prices gives the demands (Shephard's lemma). An example is the AIDS model by Deaton and Muellbauer (1980).

While the direct derivation of demand equations from the consumer's utility maximization results in these demand equations automatically satisfying the theoretical restrictions necessary, this method has shortfalls. First, there is only a limited number of known utility functions that one can use in order to solve the consumer's utility maximization problem, which greatly narrows one's available options. In addition, one cannot always derive demand equations from these utility functions, or the demand equations estimation might be problematic.

Another approach can be used in order to better suit the particular problem at hand, i.e., increasing one's flexibility, while satisfying the theoretical restrictions. According to this approach, demand equations can be directly specified, and the restrictions that make them theoretically plausible can be imposed afterwards.

These restrictions that theory implies, are most conveniently expressed in terms of derivatives of the demand equations (i.e., quantities of goods expressed as functions of prices and total income), or in terms of elasticities, which are derivatives of the logarithmic version of the demand equations (Barten, 1993).

The differential approach to estimating a demand system is advocated in this study, because of its numerous advantages. It connects consumer theory to empirical analysis, it is flexible, it allows for a choice of functional form (see general model below), and it allows for a hierarchial allocation that links demand for goods from the consumer to the import level demand and to sources of imported goods (see conditional geographic import demand system below).

Theil claims that the differential approach is an allocation or decomposition theory, that considers a total budget and how it is allocated into amounts spent on specific goods, like total imports of a country allocated over the exporting countries. He compares the system-wide approach to a view from a mountain top. While this has advantages, its disadvantages include difficulty of incorporating ad hoc explanations (for example, housewives hoarding nonperishable goods fearing a war) (Theil, pp. 5-6).

A System-wide Differential Approach to Import Demand

Only the final stages of the mathematical derivations for the following subsections are presented in the text; details can be found in Theil (1980).

The general differential model can be expressed as:

$$w_i \, d(\log q_i) = \theta_i \, d(\log Q) + \phi \sum_{j=1}^{n} (\theta_{ij} - \theta_i \theta_j) \, d(\log p_j)$$

where, p_i and q_i are the price and quantity of commodity i (i=1, ..., n), w_i is the budget share for i equal to $(p_i \, q_i)/M$, M is the total expenditure, θ_i is the marginal share of the i^{th} good, that is, the additional amount spent on this good when income increases by one dollar, with $\sum_{i=1}^{n} \theta_i = 1$, and d(log x) = dx/x for x either p or q, and all logs are natural logarithms.

The term d(log Q) is the Divisia volume index and the term d(log P) the Divisia price index, and they are weighted means of logarithmic quantity or price changes, respectively, with weights equal to the corresponding budget shares, so that $\sum_{i=1}^{n} w_i \, d(\log q_i) = d(\log Q)$ and $\sum_{i=1}^{n} w_i \, d(\log p_i) = d(\log P)$. "Changes" refer to any kind of displacement (time or other) and d(log Q), d(log P) are abbreviations. The Divisia volume index is the true index of real income which compares the utility level of (M+dM, p+dp) with that of (M,p) at the prevailing prices p, while the Divisia price index is the true cost of living index which compares p+dp with p, at the prevailing utility level u(M,P).

The ratio of the marginal share to the budget share is the income elasticity of the i^{th} good $(\theta_i/w_i) = p_i(\partial q_i/\partial M)(M/(p_iq_i)) = (\partial \log q_i)/(\partial \log M)$. The weighted mean of the income elasticities with the budget shares as weights is $\sum_{i=1}^{n} w_i (\theta_i/w_i) = \sum_{i=1}^{n} \theta_i = 1$. A good is a luxury or a necessity, if its income elasticity is larger or smaller than one, respectively. A negative income elasticity, i.e., a negative marginal share implies the good is inferior.

The term $1/\phi$ is the income elasticity of the marginal utility of income, and $\sum_{j=1}^{n} \theta_{ij} = \theta_i$ and $\sum_{i=1}^{n}\sum_{j=1}^{n} \theta_{ij} = \sum_{i=1}^{n} \theta_i = 1$, where θ_{ij}'s are the normalized price coefficients.

Following mathematical manipulations, the general restrictions of a demand system can be derived. Among those, the Slutsky equation derived, explicitly contains a specific and a general substitution effect (in addition to the income effect). The specific substitution effect refers to the specific relation in terms of u^{ij} (the $(ij)^{th}$ element of the inverse of the Hessian matrix U of the utility function u(q)) between goods i and j, while the general substitution effect refers to the competition of all goods for an extra dollar of the consumer's income. It can be shown that the substitution matrix is symmetric and negative semidefinite (Phlips, pp. 52-53).

Looking at the general differential model, the relationship between the Hicksian substitutes and complements,

and the specific substitutes and complements can be established. Since $\phi < 0$ if $\theta_{ij} < 0$, an increase in the j^{th} relative price with real income constant, increases the demand for the i^{th} good. $[\theta_{ij}]$ is symmetric so that $\theta_{ij} < 0$ implies $\theta_{ji} < 0$, and an increase in the i^{th} relative price, increases the demand for the j^{th} good. Then i and j are specific substitutes. If θ_{ij}, θ_{ji} are both positive, an increase in the relative price of either, decreases the demand for the other, so that they are specific complements. Hick's definitions refer to the total effects, so they refer to $(\theta_{ij} - \theta_i\theta_j)$ (Theil, p. 17).

Preference Structure and Conditional Demand

Preference Independence

Preference independence (PI) refers to the case of an additive utility function, $u(q) = u_1(q_1) + \ldots + u_n(q_n)$. Then the marginal utility of each good is independent of the consumption of all other goods, which means that U and U^{-1} are diagonal and $\theta_{ij} = 0$ for i not equal to j, and $\theta_{ii} = \theta_i$. Then no good is a specific substitute or complement of another, θ_{ii} is positive as a diagonal element of a positive definite matrix, and $\theta_{ii} = \theta_i$ shows that the marginal share of each good is positive, that is, there are no inferior goods under preference independence. Define $d(\log P^*) = \sum_{i=1}^{n} \theta_i \, d(\log p_i)$, as the Frisch price index, that uses marginal shares as weights. Luxuries have a greater weight in the Frisch index, and the

reverse is true for necessities. An inferior good results in its weight being negative in the Frisch index, so that an increase in the good's price lowers that index. It is the true marginal price index which compares two price vectors p and p+dp at the same utility level u(p,M) (Theil, p. 26). Then the budget shares move in the direction of the corresponding marginal shares as the consumer becomes richer (Theil, p. 27).

Substituting the Frisch price index into the general differential model one gets

$$w_i \, d(\log q_i) = \theta_i \, d(\log Q) + \phi \, \theta_i \, d(\log p_i/P^*).$$

If this last equation is divided by the budget share, θ_i/w_i is the income elasticity of demand for the i^{th} good and $\phi \, (\theta_i/w_i)$ is the own price-Frisch-deflated elasticity. Under PI the own price elasticity is proportional by $\phi < 0$ to income elasticity (Theil, p. 18).

Block Independence

If the goods can be grouped into G groups $G < n$, S_1, ..., S_G, so that each good belongs to one group, $u(q) = u_1(q_1) + \ldots + u_G(q_G)$. Then the marginal utility of each group depends only on the quantities consumed of goods that belong to the same group and U and U^{-1} are block-diagonal. The general model becomes

$$w_i \, d(\log q_i) = \theta_i \, d(\log Q) + \phi \sum_{j \in Sg} (\theta_{ij} - \theta_i\theta_j) \, d(\log p_j),$$

with $\sum_{j \in Sg} \theta_{ij} = \theta_i$, $i \in S_g$. All θ_{ij}'s with i and j in different

groups vanish, so that no good is a specific substitute or complement of a good that belongs to another group (Theil, p. 19).

To derive a demand equation for all goods in a group, define $W_g = \sum_{i \in Sg} w_i$, $\Theta_g = \sum_{i \in Sg} \theta_i$, $d(\log Q_g) = \sum_{i \in Sg} (w_i/W_g)\ d(\log q_i)$, $d(\log P_g^*) = \sum_{i \in Sg} (\theta_i/\Theta_g)\ d(\log p_i)$, $d(\log Q) = \sum_{g=1}^{G} W_g\ d(\log Q_g)$, $d(\log P^*) = \sum_{g=1}^{G} \Theta_g\ d(\log P_g^*)$, so that

$$W_g\ d(\log Q_g) = \Theta_g\ d(\log Q) + \phi\ \Theta_g\ d(\log (P_g^*/P^*)). \qquad (1)$$

Inferior goods cannot occur under block independence (BI), because $\Theta_g > 0$ (Theil, p. 99).

Blockwise Dependence

When the utility is an increasing function f, not the sum of the group utility function, $u(q) = f(u_1(q_1), \ldots, u_G(q_G))$, and $(\partial^2 U)/(\partial(p_i q_i)\partial(p_j q_j)) = \alpha_{gh}$, $i \in S_g$, $j \in S_h$, g not equal to h.

Then a change in the marginal utility of a dollar spent on the i^{th} good caused by an extra dollar spent on the j^{th} good (which belongs to a different than i group), is independent of i and j and the same for all pairs of goods in the two groups. Then

$$W_g\ d(\log Q_g) = \Theta_g\ d(\log Q) + \phi \sum_{h=1}^{G} \Theta_{gh}\ d(\log (P_h^*/P^*)) \qquad (2)$$

where

$$\Theta_{gh} = \sum_{i \in Sg} \sum_{j \in Sh} \theta_{ij}, \qquad (3)$$

$\sum_{h=1}^{G} \Theta_{gh} = \Theta_g$, $\sum_{g=1}^{G} \sum_{h=1}^{G} \Theta_{gh} = \sum_{g=1}^{G} \Theta_g = 1$ and $h = 1, \ldots, G$, $g = 1, \ldots, G$.

Because of (3), S_g, S_h are specific substitutes or complements, when Θ_{gh} is negative or positive, respectively.

Because now Θ_g can be zero, θ_i/Θ_g is replaced with θ_i^* (then if $\Theta_g = 0$, $\theta_i^* = 0$, for $i \in S_g$) so that the Frisch price index of S_g is $d(\log P_g^*) = \sum_{i \in S_g} \theta_i^* \, d(\log p_i)$. Then θ_i^* is the conditional marginal share of the i^{th} good within its group. It shows the proportion allocated to the i^{th} good, when the additional amount from an increase in income by one dollar spent on S_g is Θ_g.

After some mathematical manipulation, the conditional demand equation for the i^{th} good within its group is derived:

$$w_i \, d(\log q_i) = \theta_i^* \, W_g \, d(\log Q_g) + \phi \sum_{j \in S_g} \theta_{ij} \, d(\log (p_j/P^*)). \quad (4)$$

The consumer first uses (2) to allocate income among groups of goods. For this, knowledge of real income and the price indexes of the groups (not price changes of individual goods) is needed. Then, the consumer allocates total expenditure for each group, within the group. So, the change in the consumption volume of the group (from the first step) and price changes of all goods in the group are required.

Rotterdam Model

Following Theil (Theil, pp. 156-161), the Divisia and Frisch indexes are converted to their finite change versions: $\bar{w}_{it} = 1/2 \, (w_{i,t-1} + w_{it})$, $DP_t = \sum_{i=1}^{n} \bar{w}_{it} \, Dp_{it}$, $DQ_t = \sum_{i=1}^{n} \bar{w}_{it} \, Dq_{it}$, $DP_t^* = \sum_{i=1}^{n} \theta_i \, Dp_{it}$, where the first term is the average budget

share between period t and period t-1, i=1, ..., n, the second term is the finite version of the Divisia price index, the third the finite version of the Divisia quantity index and the fourth the finite version of the Frisch price index. Again, the left hand side terms of these indexes should be considered abbreviations for their right hand sides.

If the general differential model is converted into its finite change version, $\pi_{ij} = \phi\ (\theta_{ij} - \theta_i\ \theta_j)$ the parameters π_{ij}, θ_i are assumed constant and a disturbance term is added, the absolute price version of the Rotterdam model is

$$\overline{w}_{i}\ Dq_{it} = \theta_i\ DQ_t + \sum_{j=1}^{n} \pi_{ij}\ Dp_{jt} + \varepsilon_{it}. \qquad (5)$$

The coefficients of the second right hand side term add up to zero over j, and are called the Slutsky coefficients of the Rotterdam model. Theil shows that the disturbances ε_{it}, ..., ε_{nt} add up to zero, and all the disturbance covariances are proportional to the corresponding Slutsky coefficients.

The income elasticity is given by dividing the marginal budget share by the budget share, so that the sign of the income elasticity depends on the sign of the marginal budget share, i.e., a commodity is inferior when they are both negative and non-inferior when they are both greater than or equal to zero. For a non-inferior good to be a necessity (luxury), the marginal budget share has to be less than or equal (greater than) to the budget share, and the income elasticity less than or equal (greater than) to one.

Therefore, a good can change from luxury to necessity, depending on the change in the budget share, but it cannot change from a non-inferior good to an inferior good. While this is a limitation of the Rotterdam model, at the level of aggregation that the data are usually used, inferiority is rarely observed.

A desirable feature of the Rotterdam, is that all the general restrictions of the demand functions can be built in it, while the specific ones showing special preference structures are special cases of it.

The use of the Rotterdam parametrization allows for nested testing for homogeneity, symmetry, uniform substitutes and strong separability hypotheses, unlike alternative differential approach parametrizations (for example, the Almost Ideal Demand System by Deaton and Muellbauer, 1980).

The Rotterdam parametrization has been criticized because using it to test the homogeneity hypothesis often results in its rejection. However, Laitinen (1978) showed that it is a bias in the F test, rather a limitation of the model that causes that, and demonstrated that if a corrected version of the test is used, homogeneity is not rejected.

Another common criticism is integrability, the absence of which in the aggregate implies that the model's theoretical properties are not known. It is dealt with in conjunction with the aggregation over consumers issue discussed above, in Barnett (1979). He used a random coefficient model to perform

an aggregation analysis for an individual consumer. The coefficients used to identify each consumer are not assumed constant. Barnett's result is that the aggregate model (which has constant parameters) is a Taylor series approximation to a new theoretical construct, existing under conditions far weaker than those necessary for aggregate integrability.

A Geographic Import Allocation model

While the differential approach's different parametrizations have been used in various estimations of consumer's demand models, its application in estimating import demand has not been widely used. This is particularly true for imports of the same type products which originate from and can be differentiated by location of production. Specifically, the Rotterdam parametrization for import demand estimation of similar goods by country of origin has been used by Theil and Clements (1978), Clements and Theil (1987), Lee et al. (1990) and Seale et al. (1992). However, none of these imposed the separability condition of uniform substitutes. The advantages of this form of separability are many. Firstly, the method recognizes the close similarity of the same type product, imported from different sources. Further, it is extremely parsimonious in its use of parameters, much like the Armington model. However, unlike the Armington model, which suffers from conceptual and theoretical problems, the differential approach is based on a solid, theoretical foundation (Alston et al.; Davis and Kruse). The model

developed is also globally separable unlike that of the Deaton-Muellbauer model. The uniform substitutes restriction on a differential demand system was developed by Theil (1980) for estimating the demand for similar goods, such as brand names of the same type of good. The hypothesis has been empirically utilized only by Brown (1994), but not for import allocation or for a conditional demand system. In this study, an import demand model is developed of a similar type good from different sources of origin in a conditional framework. Thus, the functional form we develop is different from that of Brown.

The concept of multistage budgeting (Barten (1969); Seale et al.) was utilized. For the first stage, the separability structure exhibited by Egyptian domestic goods and Egyptian imported goods is assumed to be blockwise dependence. Then domestic goods and imported goods are functions of total expenditure and the relative price between these goods. Next, imports expenditure is allocated among imported goods, and finally, expenditure of a good is allocated among that good based on country of origin. Thus, a good is differentiated geographically by place of production.

Following Seale et al., a conditional geographic import demand system can be developed, according to which, total expenditure for good i, E_i, is allocated among the countries of origin (j=1, ..., n), so that E_{ij} is the expenditure on good i from country j. Thus, demand for i from the j countries can

be estimated conditionally on E_i, the expenditure spent on imported i.

The estimation of the conditional demand among countries shows the effects on the conditional trade shares when the consumption of good i changes due to a change in relative prices of i among sources j, or when total expenditure on i changes.

Let q_{ij} and p_{ij} be quantities and prices of good i from the j countries of origin, and let w_i, w_{ij} be the import (budget) shares of good i in S_i (containing countries j from which i is imported), and good i from country j, respectively. Also, $E_i = \sum_{j \in Si} E_{ij}$, so that $w_i = \sum_{j \in Si} w_{ij}$. Then θ_{ij} is the marginal share of good i from country j, and $\theta_i = \sum_{j \in Si} \sum_{k \in Si} \theta_{ijk}$ is the marginal import share of good i. θ_{ij} is the additional amount spent on good i from country j when total expenditure on all $j \in S_i$ increases by one dollar. The ratio of that to the budget share (θ_{ij}/w_{ij}) is the expenditure elasticity of the i^{th} good from the j^{th} country.

The conditional differential import demand for good i from country j is, assuming weak separability among the good from different sources,

$$w_{ij}^* \, d(\log q_{ij}) = \theta_{ij}^* \, d(\log Q_i) + \sum_{k \in Si} \pi_{ijk}^* \, d(\log p_{ik}) \qquad (6)$$

where w_{ij}^* is the conditional import share of good i from source j ($w_{ij}^* = w_{ij}/w_i$), θ_{ij}^* is the conditional marginal import share for good i from country j ($\theta_{ij}^* = \theta_{ij}/\theta_i$), π_{ijk}^*'s are the conditional Slutsky price parameters, $d(\log Q_i) = \sum_{j \in Si} w_{ij}^*$

$d(\log q_{ij})$ is the Divisia quantity index for S_i and $d(\log P_i) = \sum_{j \in Si} w_{ij}^* \, d(\log p_{ij})$ is the (conditional) Divisia price index, where $d(\log X_i) = dX_i/X_i$, with X representing either Q or P. The adding up, homogeneity and symmetry conditions are $\sum_{j \in Si} \theta_{ij}^* = 1$, $\sum_{k \in Si} \pi_{ijk}^* = 0$, and $\pi_{ijk}^* = \pi_{ikj}^*$, respectively.

The Rotterdam model's conditional absolute price version (AP) is derived by assuming the θ_{ij}^*'s and π_{ijk}^*'s constant and adding an error term, ε_{ijt}

$$\bar{w}_{ijt}^* \, Dq_{ijt} = \theta_{ij}^* \, DQ_{it} + \sum_{k \in Si} \pi_{ijk}^* \, Dp_{ikt} + \varepsilon_{ijt} \qquad (7)$$

where $\bar{w}_{ijt}^* = 1/2 \, (w_{ij,t-1}^* + w_{ijt}^*)$ and $DX_{ijt} = \log (X_{ijt}) - \log (X_{ij,t-1})$, with X equal to q, p or Q. To estimate the system, one equation is arbitrarily omitted, and the parameter estimates remain invariant to the equation omitted (Barten, 1969). Estimating (7) with homogeneity and symmetry imposed involves estimating n-1 marginal shares and n(n-1)/2 price parameters.

Under blockwise independence[1], the structure of the Slutsky price parameters is

$$\pi_{ijk}^* = \phi_i(\theta_{ijk}^* - \theta_{ij}^* \theta_{ik}^*) \qquad (8)$$

where $\theta_{ijk}^* = \theta_{ijk}/w_i$, and $\phi_i = \phi\theta_i/W_i$ is a factor of proportionality specific for the group S_i.

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[1] For the derivation of the blockwise dependence case, see Seale, 1996.

The π_{ijk}^{*}'s can be restricted by various assumptions to make the model much more parsimonious in terms of degrees of freedom. One such restriction is based on the separability conditions due to uniform substitutes. Imports of wheat, for example, from different sources are similar but differentiated products, much like brand-name goods. If wheats from different sources are uniformly substitutable, then the marginal utility of a dollar spent on wheat by each source declines by the same amount when an additional dollar is spent on any other wheat by source (Theil, 1980, p. 200). It can be shown that equation (6) for uniform substitutes (by restrictions (8)) becomes (Theil, 1980, pp. 166, 200)

$$w_{ij}^{*}\, d(\log q_{ij}) = \theta_{ij}^{*}\, d(\log Q_i) + \phi_i^{*}\, \theta_{ij}^{*}\, d(\log p_{ij}/P_i') \quad (9)$$

where $\phi_i^{*} = \phi_i/(1-R\theta_i)$, R is a positive value and $d(\log P_i') = \sum_{k \in Si} \theta_{ik}^{*}\, d(\log p_{ik})$ is the Frisch conditional price index (with conditional marginal shares as weights).

The finite version of the Uniform Substitutes (UB) model becomes

$$\bar{w}_{ijt}^{*}\, Dq_{ijt} = \theta_{ij}^{*}\, DQ_{it} + \phi_i^{*}\theta_{ij}^{*}\, D(p_{ijt}/P_{it}') + \xi_{ijt} \quad (10)$$

Models (7) and (10) are nested and the likelihood ratio test can be used to test the UB hypothesis for goods i from different sources. Finally, it should be noted that when R=0, the model is restricted to one of preference independence (strong separability). (See Seale et al. for estimation of a

separable allocation model under the assumption of preference independence.)

CHAPTER 5

DATA, ESTIMATION AND RESULTS

Data

For the estimation of the model, import data from the United Nations (UN) was used. The description of the wheat and wheat flour commodities was based on the Standard International Trade Classification, Revision I. Wheat flour was assumed to be a different commodity than wheat, for reasons explained in the introductory chapters (also see estimation of Egyptian import demand for flour, Pana-Cryan and Seale, 1995).

As mentioned in earlier sections, in this study aid is treated as an income transfer. In the estimated model, amounts of aid to Egypt by donor were subtracted from the UN data that include aid, in order to compare imports by source net of aid shipments (Pana-Cryan and Seale include aid amounts in the estimation). The aid shipments reported in AGROSTAT show totals of wheat and wheat flour in grain equivalents. To derive wheat aid only amounts, the percentage of wheat imports to total wheat and flour imports (in grain equivalents) was estimated for each year and country of origin. Then this percentage was applied to the gross aid figures in order to derive wheat aid only by country of origin.

Table 8 presents the commercial quantities of wheat imported (net of aid) and their values by selected suppliers. Since the

Table 8. Commercial Quantities and Values of Imported Wheat by Selected Suppliers, Egypt, 1973-93.

Year	US	EU	Australia	Other
		MT		
1973	141067	396473	552062	213614
1974	654604	608575	720354	145728
1975	632983	589935	833567	124823
1976	583149	378024	707455	19451
1977	305835	27520	506568	512770
1978	424632	311598	365684	1022740
1979	327812	363565	214855	340601
1980	179338	752468	223057	2340
1981	916948	358490	751029	143458
1982	1030197	53245	669303	148803
1983	764327	375265	639186	104056
1984	182996	233463	1022481	627398
1985	147007	817	1214326	367191
1986	658978	0	1765813	270308
1987	1140399	126556	1356735	123930
1988	857484	429821	1113223	319457
1989	1635289	235859	608692	30957
1990	721453	899246	1805461	375670
1991	558643	18204	1851598	238239
1992	3118350	50419	1193638	2646
1993	559603	280506	726502	208481
		$1000		
1973	17001	53754	37178	31597
1974	171376	177772	196845	48712
1975	222337	123707	158641	39674
1976	181245	80244	121255	9748
1977	168498	5505	79317	75337
1978	173250	48860	46478	155543
1979	152304	36650	27567	32535
1980	220667	169481	47517	3605
1981	438077	89787	191173	39822
1982	472342	10798	174976	45082
1983	242474	90064	141453	22644
1984	139455	44482	238791	114222
1985	69157	126	159402	41247
1986	172118	0	281716	46028
1987	172804	30085	144236	35403
1988	202316	40447	183348	11900
1989	390737	46163	137172	11793
1990	223572	160394	333877	71245
1991	214847	32564	225188	34201
1992	478108	17061	200562	8926
1993	156608	43939	127908	7066

Sources: United Nations, Commodity Trade Statistics, FAO, AGROSTAT.

main interest of the study regards the position of the US in the Egyptian import market, the years selected start in 1973 because there were no US exports to Egypt during the previous war years. In 1986 there were no imports from the EU, so that year was excluded as well (the model estimated does not accept zero values).

The AP and UB versions of the conditional Rotterdam were estimated using the seemingly unrelated regressions procedure in Times Series Processor (TSP).

Testing Restrictions

Model (7) was estimated with no restrictions, with homogeneity imposed and with symmetry imposed for wheat imported to Egypt by country of origin. The logs of the concentrated likelihood functions for these estimations are presented in Table 9. The likelihood ratio test (LR) is minus twice the log ratio of the restricted to the unrestricted concentrated likelihood function and is asymptotically distributed as a chi-squared with degrees of freedom equal to the number of restrictions. Homogeneity could not be rejected when tested against the unrestricted model (α=0.01). Also, symmetry was tested against the model with homogeneity imposed, and again could not be rejected (α=0.01). Finally, the uniform substitutes restriction was imposed and the calculated statistic was 12.58, which is less than the critical value of the chi-squared at α=0.01 (the hypothesis could not be rejected at this level of significance).

It should be noted that this is a nested testing framework, so that each nested test is conditional on the failure to reject the

Table 9. Log of Likelihood Functions for Conditional Rotterdam Model Under Different Restrictions.

Restrictions	Log Lik.	
Free Rotterdam	46.857	(15)
Homogeneity	46.403	(12)
Symmetry	43.482	(9)
Uniform Substitutes	37.192	(5)

Note: In parentheses are the numbers of free parameters for each model.

previous hypothesis. At the level of uniform substitutes, the overall significance is approximately the sum of the significance levels of all three tests.

Whereas the coefficients of determination R^2 for the individual equations are meaningless, testing for goodness of fit for the whole system is possible using modified measures of R^2. An example is the one by McElroy (1977), that can be calculated according to the formula $R_*^2 = 1-1/(1+W/(T-k)(n-1))$, where W is the Wald test statistic, T is the number of observations, k is the number of regressors in each equation, and n is the number of equations in the system (Bewley, p. 188). Taking into account all the shortcomings of a measure like that (Greene, p. 513) and also that the statistic will vary depending on which equation of the system is dropped, the statistic was calculated with the rest of the world (ROW) equation dropped because it was the least interesting for the purpose of this study. The values for the statistic are .93 and .98 for the symmetry AP and the UB version, respectively.

Conditional Marginal Shares

The conditional marginal import shares show how an additional dollar spent on imported good i is allocated among sources for that good. The parameter estimates are reported in Table 10 for the Rotterdam UB case, and Table A-1 in the Appendix for the AP case[1].

[1] In the sections that follow the UB results will be presented. A summary of the AP results will be discussed at the end of the present chapter.

Table 10. Parameter Estimates for Egyptian Wheat Imports by Sources, Rotterdam UB, 1973-85, 1987-93.

Exporting Country	Slutsky Price Coefficients				Conditional Marginal Shares	Factor of Proportionality
	US	AUS	EU	ROW		
US	-0.309	0.185	0.070	0.053	0.550	-1.248
	(0.050)	(0.056)	(0.024)	(0.014)	(0.060)	(0.194)
AUS		-0.246	0.034	0.026	0.270	
		(0.068)	(0.014)	(0.009)	(0.068)	
EU			-0.115	0.010	0.102	
			(0.036)	(0.004)	(0.037)	
ROW				-0.089	0.078	
				(0.023)	(0.024)	

Note: In parentheses are asymptotic standard errors.

In the UB version all estimates are positive and significantly different from zero. According to that version, for an additional dollar of wheat imported into Egypt, 55 cents would be spent on US wheat, 27 cents on Australian and 10 cents on European wheat.

The hypothesis of equality among the conditional marginal shares for US, Australian and European wheat imported to Egypt is rejected (α=0.05).

Expenditure Elasticities

The conditional expenditure elasticities are calculated by dividing the conditional marginal import shares by the mean of the average import shares. They show how a 1% change in expenditure for a good would affect the percentage change in quantities of the good imported from each country. The results are reported in columns one in Tables 11 and A-2 for the UB and AP versions of the model, respectively.

In the UB case, all results are significantly different from zero. According to that version of the model, a 1% expansion in the Egyptian imported wheat market will cause an increase in wheat quantities imported from the US, while the import shares from other sources will decline. However, the hypothesis of equality among the expenditure elasticities for wheat imported to Egypt from different sources could not be rejected.

Price Parameters

The conditional Slutsky price parameters for imported wheat by country of origin are reported in columns one through four in Tables 10 and A-1 for the UB and AP versions, respectively. The

factor of proportionality was used to calculate the UB version coefficients. Along the diagonals are the own-price estimates and the off-diagonals suggest substitution if positive and complementarity if negative according to the Hicksian definitions. In the UB case the own-price estimates are negative as expected. They are also significant. The hypothesis of equality among own-price parameters for wheat from different sources is rejected.

The cross price results are all positive and significantly different from zero for the UB case. Therefore, the results imply that wheat imports from different sources are substitutes.

Price Elasticities

Three kinds of price elasticities were calculated for the AP and the UB versions of the model, namely, Slutsky, Cournot and Frisch.

The conditional Slutsky price elasticities are calculated by dividing the estimated Slutsky price parameters by the mean of the average import shares and are reported in Tables 11 and A-2. They show the percentage change in quantities demanded that result from a 1% change in price, holding real expenditures on imported wheat constant. They correspond to a Hicksian demand curve and are all significant for the UB version. The hypothesis of equality among the conditional Slutsky price elasticities for wheat from different sources of origin could not be rejected.

The conditional Cournot price elasticities are calculated using,

Table 11. Egyptian Expenditure and Slutsky Price Elasticities of Import Demand for Wheat by Source, Estimated at Sample Means, Rotterdam UB.

Exporting Country	Expenditure Elasticities	Slutsky Price Elasticities			
		US	AUS	EU	ROW
US	1.201	-0.674	0.404	0.153	0.116
	(0.130)	(0.110)	(0.122)	(0.052)	(0.031)
AUS	0.880	0.604	-0.801	0.112	0.085
	(0.221)	(0.183)	(0.220)	(0.044)	(0.030)
EU	0.750	0.515	0.252	-0.840	0.073
	(0.270)	(0.173)	(0.100)	(0.268)	(0.033)
ROW	0.787	0.540	0.265	0.100	-0.905
	(0.244)	(0.145)	(0.094)	(0.046)	(0.228)

Note: In parentheses are asymptotic standard errors.

$$C_{ij} = (\pi_{ij}^{*} - \theta_i^{*} \ \bar{w}_j^{*}) / \ \bar{w}_i^{*}$$

where π_{ij}^{*} the conditional Slutsky coefficients, $\bar{w}_i^{*}$ and $\bar{w}_j^{*}$ average conditional budget shares and θ_i^{*} conditional marginal share. These elasticities express substitution and income effects resulting from price changes, holding nominal income constant, and correspond to a Marshallian demand. Tables 12 and A-3 present the results for the UB and AP versions, respectively.

According to the UB version, the Cournot own-price elasticities are negative and significantly different from zero. However, the hypothesis of equality among the own-price elasticities for different suppliers could not be rejected.

Frisch price elasticities are calculated according to the formula $F_{ij} = (\pi_{ij}^{*} + \phi_i \ \theta_i^{*} \ \theta_j^{*}) / \ \bar{w}_i^{*}$, holding the marginal utility of income constant. The results are presented in Tables 13 and A-4 for the UB and AP versions of the model, respectively.

The cross-price elasticities vanish for the UB case. The own-price elasticities are all negative and significant, but the hypothesis of equality among them could not be rejected.

Summary of AP Results

The Rotterdam AP version conditional marginal shares estimates are positive. They are also significantly different from zero, except for the EU estimate. Compared to the UB case, they are

Table 12. Egyptian Cournot Price Elasticities of Import Demand for Wheat by Source, Estimated at Sample Means, Rotterdam UB.

Exporting Country	Cournot Price Elasticities			
	US	AUS	EU	ROW
US	-1.224	0.036	-0.012	-0.002
	(0.102)	(0.143)	(0.055)	(0.032)
AUS	0.201	-1.071	-0.008	-0.002
	(0.112)	(0.282)	(0.040)	(0.023)
EU	0.171	0.022	-0.942	-0.001
	(0.084)	(0.088)	(0.301)	(0.020)
ROW	0.180	0.024	0.007	-0.983
	(0.077)	(0.092)	(0.036)	(0.249)

Note: In parentheses are asymptotic standard errors.

Table 13. Egyptian Frisch Price Elasticities of Import Demand for Wheat by Source, Estimated at Sample Means, Rotterdam UB.

Exporting Country	Frisch Price Elasticities			
	US	AUS	EU	ROW
US	-1.498 (0.245)			
AUS		-1.098 (0.394)		
EU			-0.936 (0.332)	
ROW				-0.981 (0.269)

Note: In parentheses are asymptotic standard errors.

lower for all sources of origin except the US, for which the AP estimate is higher than the UB one.

The expenditure elasticities estimates are significantly different from zero, except for the EU estimate. With respect to the magnitude of the estimates, the AP estimates are lower than the UB ones, except for the US case, where the reverse is true.

The own-price estimates are all negative and significant. The AP case includes a negative cross-price estimate (AUS-ROW), but it is not significantly different from zero.

The own-price Slutsky elasticities are negative and significant, while the cross-price estimates are positive except for Australia and the ROW, for which they are negative but insignificant.

The Cournot own-price elasticities are negative and significantly different from zero. They are also similar in the two models.

The Frisch own-price elasticities are higher for all suppliers except the US, and the cross-price estimates are all negative except the ones including the US.

CHAPTER 6

SUMMARY, CONCLUSIONS, LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Summary and Conclusions

The geographic wheat import allocation model for Egypt was utilized to assess the US position in this market compared to other major Egyptian suppliers, namely the EU and Australia. Testing among alternative hypotheses, the UB version of the model could not be rejected. The UB hypothesis implies that when an additional dollar is spent on wheat by one source, the marginal utility of a dollar spent on wheat by each other source declines by the same amount.

When an additional dollar of wheat imported into Egypt is spent, the conditional marginal share estimates suggest that 55 cents of it would be spent on US wheat, 27 cents on European wheat and 10 cents on Australian wheat. The negative cross price parameters imply that Egyptian wheat imports from different sources are substitutes.

Domestic and export policies in the wheat markets for the Egyptian suppliers can potentially affect Egyptian wheat imports. Australia is considered a small country and policy changes in its wheat market do not affect the Egyptian imports. The EU and the US policies affect the wheat world price however, which in turn causes changes in the quantities of world wheat exports and ultimately,

Egyptian wheat imports. For example, following the analysis in chapter 3, if the US eliminates deficiency payments to its wheat producers, the world price for wheat will increase. The estimated model however, assumes four wheat exporting areas and a single import market which is only a portion of the wheat traded on the world market. One interpretation of the resulting "world price" in chapter 3 resulting from the removal of the US deficiency payment program is simply the "offering price" by the US, assuming no policy changes by other exporters[1].

The estimated model predicts what would happen in the Egyptian wheat import market when the offering wheat price from an individual supplier changes, assuming the rest of the suppliers' prices remain constant. According to Table 11, a 1% increase in the US wheat offering price resulting from such a policy change as above will reduce the Egyptian wheat quantity imported from the US by 0.67%, while the EU wheat quantity imported to Egypt will increase by 0.52% and the Australian wheat quantity imported to Egypt will increase by 0.60%.

An alternative scenario would be the removal of export subsidies by the EU, resulting in an increase in their offer price to the world market. A 1% increase in the EU offering wheat price, for example, will decrease wheat imported to Egypt from the EU by 0.84%, while the US wheat imports to Egypt will increase by 0.15% and the Australian imports to Egypt by 0.11%.

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[1] This abstracts from the other mixture of programs affecting the US grain market for the sake of illustrating the application of the estimated model.

The assumption that a policy change by one supplier will not cause a change in other suppliers' policies refers to the short run. In the long run competitors policies will change as well, but the model does not examine that scenario.

If the Egyptian government did not set the wheat prices for consumers and producers, the domestic supply would also increase, and the consumers would face higher wheat prices. While the quantity of imports would decrease, the elimination of price interventions in Egypt would not affect the wheat world price.

Limitations and Suggestions for Further Research

The limitations of the study that are mentioned refer to the Rotterdam model's choice and the assumption of Egypt being a small country. While these are considered the most important limitations, there exist certainly more, as is the case in most modelling efforts.

The advantages and disadvantages of the Rotterdam model were explored in the theoretical and methodological sections. Its desirable properties as a geographical allocation model were the main reason it was chosen for this study. Some of the model's limitations include its inability to incorporate ad hoc explanations, the fact that a good can change from a luxury to a necessity, but it cannot change from a non-inferior to an inferior good, and the model's logarithmic formulation, which means it does not accept zero data values.

Another limitation of the study refers to the assumption that Egypt is a small country for trade purposes. While it was assumed

that Egypt can not affect the world price for wheat, an argument can be made against this point. Not only is Egypt the third largest wheat importer, political reasons might provide it with additional leverage to negotiate and receive lower wheat imports price than what the small country case would predict. More in depth research on whether or not the small country assumption is reasonable is needed.

The models estimated are conditional on expenditure allocated for wheat imports. If relevant data were available one could calculate unconditional expenditure elasticities, that would show what happens to the wheat import market with changes in total expenditure. For each stage (stages are described in the development of the geographic allocation model) one could obtain expenditure elasticities that if multiplied would result in the unconditional ones. For example, the conditional expenditure elasticity for US wheat imported to Egypt multiplied by the expenditure elasticity for all imported wheat would be the unconditional elasticity for US wheat imported to Egypt.

APPENDIX

ROTTERDAM AP RESULTS

Table A-1. Parameter Estimates for Egyptian Wheat Imports by Sources, Rotterdam AP, 1973-85, 1987-93.

Exporting Country	Slutsky Price Coefficients				Conditional Marginal Shares
	US	AUS	EU	ROW	
US	-0.434	0.257	0.087	0.090	0.344
	(0.066)	(0.055)	(0.040)	(0.023)	(0.089)
AUS		-0.257	0.021	-0.021	0.353
		(0.059)	(0.024)	(0.019)	(0.067)
EU			-0.117	0.008	0.134
			(0.043)	(0.023)	(0.080)
ROW				-0.077	0.169
				(0.022)	(0.061)

Note: In parentheses are asymptotic standard errors.

Table A-2. Egyptian Expenditure and Slutsky Price Elasticities of Import Demand for Wheat by Source, Estimated at Sample Means, Rotterdam AP.

Exporting Country	Expenditure Elasticities	Slutsky Price Elasticities			
		US	AUS	EU	ROW
US	0.751	-0.947	0.837	0.640	0.910
	(0.195)	(0.145)	(0.178)	(0.295)	(0.234)
AUS	1.152	0.560	-0.838	0.153	-0.210
	(0.219)	(0.119)	(0.192)	(0.179)	(0.190)
EU	0.979	0.191	0.068	-0.854	0.084
	(0.586)	(0.088)	(0.080)	(0.313)	(0.231)
ROW	1.713	0.196	-0.068	0.061	-0.784
	(0.620)	(0.050)	(0.061)	(0.167)	(0.223)

Note: In parentheses are asymptotic standard errors.

Table A-3. Egyptian Cournot Price Elasticities of Import Demand for Wheat by Source, Estimated at Sample Means, Rotterdam AP.

Exporting Country	Cournot Price Elasticities			
	US	AUS	EU	ROW
US	-1.291	0.330	0.088	0.122
	(0.116)	(0.157)	(0.098)	(0.057)
AUS	0.309	-1.191	-0.089	-0.181
	(0.129)	(0.240)	(0.086)	(0.065)
EU	0.192	-0.147	-0.988	-0.036
	(0.337)	(0.265)	(0.332)	(0.187)
ROW	0.126	-0.735	-0.173	-0.953
	(0.315)	(0.266)	(0.188)	(0.248)

Note: In parentheses are asymptotic standard errors.

Table A-4. Egyptian Frisch Price Elasticities of Import Demand for Wheat by Source, Estimated at Sample Means, Rotterdam AP.

Exporting Country	Frisch Price Elasticities			
	US	AUS	EU	ROW
US	-1.269	0.229	0.065	0.038
	(0.050)	(0.051)	(0.019)	(0.025)
AUS	0.343	-1.345	-0.124	-0.311
	(0.077)	(0.079)	(0.030)	(0.038)
EU	0.220	-0.278	-1.017	-0.311
	(0.065)	(0.067)	(0.025)	(0.038)
ROW	0.175	-0.965	-0.202	-1.146
	(0.114)	(0.117)	(0.044)	(0.056)

Note: In parentheses are asymptotic standard errors.

REFERENCES

Alderman, H. and J. von Braun. The Effects of the Egyptian Food Ration and Subsidy System on Income Distribution and Consumption. Research Report 45, International Food Policy Research Institute, Washington D.C., 1984.

Alston, J. M., C. A. Carter, R. Green, and D. Pick. "Whither Armington Trade Models?". American Journal of Agricultural Economics 72 (May 1990), pp. 455-67.

Antle, J. "Agriculture in the National Economy". In The Agriculture of Egypt ed., G. M. Craig. Oxford University Press, New York, 1993.

Barnett, W. A. "Theoretical Foundations for the Rotterdam Model". Review of Economic Studies 46(1) (1979), pp. 109-30.

Barten, A. P. "Maximum Likelihood Estimation of a Complete System of Demand Equations." European Economic Review 1 (1969), pp. 7-73.

Barten, A. P. "The Systems of Consumer Demand Functions Approach: A Review." Econometrica 45 (1977), pp. 23-51.

Barten, A. P. "Consumer Allocation Models: Choice of Functional Form." Empirical Economics 18 (1993), pp. 129-58.

Bewley, R. Allocation Models: Specification, Estimation and Application. Ballinger Publishing Co., Cambridge, Massachusetts, 1986.

Brenton, P. A. "The Allocation Approach to Trade Modelling: Some Tests of Separability Between Imports and Domestic Production and Between Different Imported Commodity Groups". Weltwirtschaftliches Archiv 125(2) (1989), pp. 230-51.

Brown, A. and A. Deaton. "Surveys in Applied Economics: Models of Consumer Behavior". Economic Journal 82 (1972), pp. 1145-1236.

Brown, M. G. "Demand Systems for Competing Commodities: An Application of the Uniform Substitute Hypothesis." Florida Agricultural Experiment Station Journal Series No. R-03158, 1994.

Clements, K. W. "Alternative Approaches to Consumption Theory." In Applied Demand Analysis by H. Theil, Ballinger Publishing Company, Cambridge, Massachusetts, 1987.

Clements, K. W. and H. Theil. "A Simple Method of Estimating Price Elasticities in International Trade." Economics Letters 1 (1987), pp. 133-137.

Davis, G. C. and N. C. Kruse. "Consistent Estimation of Armington Demand Models." American Journal of Agricultural Economics 75 (August 1993), pp. 719-723.

Deaton, A. and J. Muellbauer. "An Almost Ideal Demand System." American Economic Review 70 (1980), pp. 312-26.

Dethier, J. J. Trade, Exchange Rate, and Agricultural Pricing Policies in Egypt. World Bank, Washington D.C., 1989.

Europa World Yearbook 1989. Europa Publications Limited, London, 1989.

ez Elarab, M. "An Estimation of a Complete Demand System for Egyptian Imports Under a Separable Utility Function." Ph.D. Thesis, North Carolina State University, 1982.

Foreign Agricultural Service of the United States. Agricultural Statistical Annual Report: Egypt Report 1994, Washington D.C., 1995.

Food and Agricultural Organization of the United Nations. AGROSTAT (Computer Files) Rome, 1994.

Greene, W. H. Econometric Analysis. Macmillan Publishing Co., New York, 1990.

Handoussa, H. "The Impact of Foreign Aid on Egypt's Economic Development, 1952-1986." In Transitions in Development: The Role of Aid and Commercial Flows ed., U. Lele and I. Nabi, International Center for Economic Growth, San Francisco, California, 1991.

Hansen, B. The Political Economy of Poverty, Equity, and Growth: Egypt and Turkey. Oxford University Press for the World Bank, Oxford, 1991.

Hicks, J. R. Value and Capital. Second ed., Oxford University Press, Oxford, 1946.

Laitinen, K. "Why is Demand Homogeneity so Often Rejected?" Economics Letters 1 (1978), pp. 187-191.

Lee, J.-Y., J. L. Seale, Jr., and P. A. Jierwiriyapant. "Do Trade Agreements Help U.S. Exports? A Study of the Japanese Citrus Industry." Agribusiness 6 (1990), pp. 505-14.

McElroy, M. B. "Goodness-of-Fit for Seemingly Unrelated Regressions." Journal of Econometrics 6 (1977), pp. 381-87.

Moschini, G., D. Moro and R. D. Greene. "Maintaining and Testing Separability in Demand Systems." American Journal of Agricultural Economics 76 (February 1994), pp. 61-73.

Organization for Economic Cooperation and Development. Agricultural Policies, Markets and Trade in OECD Countries: Monitoring and Outlook 1995. Author, Paris, 1995.

Pana-Cryan, R. and J. L. Seale, Jr. "A Geographic Allocation Model for Egyptian Import Demand for Wheat, Corn, and Flour." Paper presented at the annual meetings of the American Agricultural Economics Association, San Antonio, Texas, 1996.

Parker, J. and S. Shapouri. Determinants of Wheat Import Demand: Egypt. United States Department of Agriculture, Agriculture and Trade Analysis Division, Commodity Economics Division, Washington, D.C., November 1993.

Phlips, L. Applied Consumption Analysis. North-Holland, Amsterdam, 1983.

Powell, A. A. Empirical Analytics of Demand Systems. D. C. Heath and Co., Lexington, Massachusetts, 1974.

Robinson, S. and C. Gehlhar. Land , Water and Agriculture in Egypt: The Economywide Impact of Policy Reform. Trade and Macroeconomics Division, International Food Policy Research Institute, Washington D.C., September 1994.

Sarris, A. "Structural Adjustment and Agricultural Development in Egypt: Policies, Prospectives and Options." In Agricultural Policy Analysis in Egypt:Selected Papers ed., F. K. Bishay, S. Nassar and D. Abdou. Food and Agricultural Organization of the United Nations Economic and Social Development Paper 129, Food and Agricultural Organization of the United Nations, Rome, 1994.

Scobie, G. M. "Government Policy and Food Imports." Research Report 29, International Food Policy Research Institute, Washington D.C., 1981.

Scobie, G. M. "Food Subsidies in Egypt: Their Impact on Foreign Exchange and Trade." Research Report 40, International Food Policy Research Institute, Washington D.C., 1983.

Seale, J. L. Jr. "Uniform Substitutes and Import Demand for Products Differentiated by Source." Paper presented at the University of California, Davis, January, 1996.

Seale, J. L. Jr., A. L. Sparks and B. M. Buxton. "A Rotterdam Application to International Trade in Fresh Apples: A Differential Approach." Journal of Agricultural and Resource Economics, 17(1) (1992), pp. 138-149.

Theil, H. The System-Wide Approach to Microeconomics. The University of Chicago Press, Chicago, 1980.

Theil, H. and K. W. Clements. "A Differential Approach to US Import Demand." Economics Letters 1 (1978), pp. 249-252.

Truett, L. J., D. B. Truett and B. E. Apostolakis. "The Translog Cost Function and Import Demand: The Case of Mexico". Southern Economic Journal 60(3) January 1994, pp. 685-700.

TSP International. Time Series Processor (Computer Software), 1993.

United Nations. Commodity Trade Statistics (Computer Files), 1994.

United Nations. Standard International Trade Classification, Revision I. Author, New York, 1963.

United States Department of Agriculture. Foreign Agricultural Trade of the United States, January/February 1994. Author, Washington D.C., 1994.

United States Department of Agriculture. Foreign Agricultural Trade of the United States, January/February 1996. Author, Washington D.C., 1996.

von Braun, J. and H. de Haen. "The Effects of Food Price and Subsidy Policies on Egyptian Agriculture." Research Report 42, International Food Policy Research Institute, Washington D.C., 1983.

Winters, L. A. "Separability and the Specification of Foreign Trade Functions". Journal of International Economics 17 (1984), pp. 239-263.

World Bank. Arab Republic of Egypt: An Agricultural Strategy for the 1990s. Country Study, Author, Washington D.C., 1993.

World Bank. STARS (Computer files), 1994.

World Bank. World Tables, 1993-94 ed. Johns Hopkins University Press, Baltimore, 1994.

BIOGRAPHICAL SKETCH

Regina Pana-Cryan was born in 1961 in Athens, Greece. After graduating from high school, she attended the American College of Greece in Athens, were she studied business administration, and received a B.S. in accounting and finance in December 1987. While enrolled in the American College of Greece, she attended the University of Thessaloniki in Thessaloniki, Greece, where she studied agriculture and received a BS in plant science in February 1989. In August of the same year she enrolled at the University of Florida, Food and Resource Economics Department. She graduated with an MS in December 1991 and enrolled in the Ph.D. program in the same department. She is currently a prevention effectiveness fellow at the Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, in Atlanta, Georgia.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert D. Emerson, Chair
Professor of Food and Resource Economics

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James L. Seale, Jr., Cochair
Professor of Food and Resource Economics

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Max R. Langham
Professor Emeritus of Food and Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Elias Dinopoulos
Professor of Economics

This dissertation was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1996

Jack L. Fry

Dean, College of Agriculture

Dean, Graduate School

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